

Form ESA-B4. Summary Report for ESA-242-2

Public Report - Final

Company	Murphy Oil USA	ESA Dates	November 12 - 14, 2007
Plant	Superior Plant	ESA Type	Pumps
Product	Oil refinery	ESA Specialist	Beka Kosanovic

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction: Murphy Oil Corporation is a worldwide oil and gas exploration and production company with refining and marketing operations in the United States and the United Kingdom, and crude oil and natural gas exploration and production operations in Canada. The company has refineries in Meraux, Louisiana, and Superior, Wisconsin. Murphy USA Marketing Co. (Murphy Oil USA, Inc.) operates retail gasoline stations under the Murphy USA® brand in 20 states in the U.S. The company has 7,296 employees worldwide, and annual sales of over \$14 billion. The Superior refinery processes approximately 12,000,000 barrels of oil annually. Currently the average daily production is approximately 32,000 barrels per day.

Power consumption for the plant was approximately 12 megawatts.

An Energy Savings Assessment (ESA) was performed at the Superior Wisconsin facility to analyze the plant's pumping systems in general, and its crude oil refining system in particular. Mr. Jerry Choate and Mr. Timothy Thom were the primary supports for this assessment, and Mr. Sam Talarico participated in the assessment. DOE's pump systems specialist Dr. Beka Kosanovic led the assessment. Prior to the assessment, Dr. Kosanovic discussed details of the assessment with the Murphy Oil team, reviewed available data on energy use in the plant, and obtained partial information on equipment specifications.

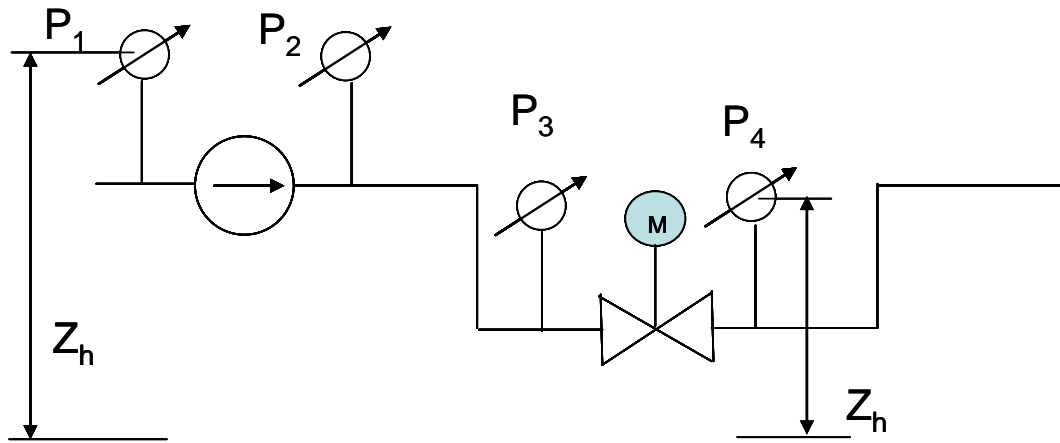
Objective of ESA: The main objectives of the assessment were to use the Pump System Assessment Tool (PSAT) to identify energy saving opportunities for selected pumping systems in the plant, to provide hands-on training and demonstration of the data collection process, and to analyze the results in order to estimate potential savings for the identified opportunities.

Focus of Assessment: The assessment focused on pumps in the crude oil operations unit. The Sulfur Recovery and Hydrofluoric Acid Alkylation Unit systems were not included in this assessment. Due to the large number of pumps in the facility, only energy saving opportunities for major pumps were considered during this assessment. Many smaller pumps with similar modes of operations were left for future consideration by plant personnel. All pumps considered during this assessment had a loop configuration almost identical to the one presented in the figure below. In order to transport crude oil, pressure is increased with a constant speed centrifugal pump. The oil is then passed through a motorized valve to adjust the flow to the desired level. During the assessment it was noticed that valves were throttled in order to achieve desired flows, creating substantial pressure drops in some applications. This created an opportunity to use PSAT, to quantify energy losses and associated costs at those locations. Even though the plant has pretty steady daily production volume depending on the type of oil refined, heavy or light, and on the specifications of the final product, the variations in flow for all processes can be significant. The results presented in this analysis offer just a snapshot of the potential savings. Further investigations are necessary to evaluate all major system set-ups in order to predict the savings more accurately.

Approach for ESA: The assessment activities included (a) a review of energy use by the plant, (b) a plant tour, (c) a demonstration of PSAT and instructions on its use, (d) collection of the required data for PSAT, and (e) analysis of energy saving opportunities for the systems mentioned above. The performance information was derived from historical data, or actual measurements carried out during the assessment. The plant Manager of Operations, Mr. Kollin Schade, was briefed on the assessment results on the third day of the assessment. In addition to Mr. Choate, Mr. Thom and Mr. Talarico, Mr. Dean Laube of Franklin Energy, representing Wisconsin Focus on Energy and Jeff Wiklund, key account manager for Minnesota Power were also present at the final meeting.

General Observations of Potential Opportunities: Murphy Oil USA plant management is very active in exploring and implementing energy saving practices throughout the plant. Assessment team members provided help and cooperation in discussing and collecting performance data, and showed great enthusiasm for continuing to use the methodology and tools demonstrated during this assessment.

The picture below represents a typical system setup in the process. In order to evaluate system operations, it was necessary to collect information on pressure readings and elevations of all pressure gauges. In addition to flow, temperature and specific gravity of the fluid transported, all pipe diameters and regulating valve sizes were collected. For all motors rated at 460 Volts, readings of voltage, amperage, power factor and actual power (kW) were measured. In the case of the 2,300 Volt motor, which is on the raw crude oil pump, the amperage from the control panel was used for the evaluation.



Major energy saving opportunities identified during this assessment are described briefly below. The main recommendation was to install VFDs on the circulating pumps, instead of throttling to achieve desired flows. Identified energy savings opportunities have the potential for savings varying from as little as \$4,000 to as high as \$70,000 per year for the equipment assessed during this visit. These savings are based on a “spot-check” of selected equipment operating at the condition that existed when the assessment was carried out. This estimate of savings should be considered as a sample of possible savings. Plant personnel attending the assessment have shown a willingness to use the PSAT program and methodology to calculate savings for other equipment, over a longer operating period.

Total electricity savings for all measures were estimated at 4,713,600 kWh, for a total annual savings of \$181,150. This represents a reduction of approximately 4.4% in the plant’s electric energy use and energy cost. Based on the recommendations, and on discussions with facility personnel and management, our estimate of possible savings categorized by ease of implementation is as follows:

- a) Near-Term opportunities: 2,489,000 kWh electricity
- b) Medium-Term opportunities: 395,000 kWh electricity
- c) Long-Term opportunities: 1,829,000 kWh electricity.

The following provides additional description of each of the potential opportunities:

1. The plant runs one 400 hp “raw crude” pump to transport crude oil through a set of heat exchangers. This pump is increasing pressure from 82 to 422 psig. The pressure is reduced to 255 psig after the motorized valve that creates a pressure drop of over 150 psi. The recommendation was made to upgrade the raw crude pump with a variable frequency drive. This will allow the plant to vary flow without excessive throttling, and will result in lower energy consumption for the pump motor. This measure offers potential savings of about 729,000 kWh, or \$28,000 per year.
2. The plant runs one 125 hp “desalted crude” pump. This pump increases pressure from 180 to 298 psig. The pressure is reduced to 136 psig after the motorized valve that creates a pressure drop of over 160 psi. The recommendation was made to evaluate operations of this pump more closely, as the pressure on the intake of this pump is sufficient to overcome all losses in this loop. It is possible that this pump could be completely removed from the operation. Depending on desired flows at different operating conditions, it is possible that this pump is needed for some production runs and if that proves to be the case it should be upgraded with the addition of a variable frequency drive. This measure offers potential savings of about 1,290,000 kWh, or \$49,700 per year.
3. One 150 hp “vacuum bottom” pump was measured to be running at 77 kW. Information was available for this pump for a couple of operating conditions. In one case the pressure drop across the regulating valve was more than 160 psi. In the other case it was only 12 psi. This indicates that this pump is also a good candidate for installation of variable speed drive. An average for these two conditions was used to estimate potential savings of about 470,000 kWh, or \$18,000 per year.

4. One 75 hp “heavy naptha” pump was measured to be running at 29.7 kW. The pressure drop across the motorized regulating valve was measured to be 60 psi. This pump is also a candidate for a variable speed drive. This measure offers potential savings of about 282,000 kWh, or \$10,800 per year.
5. One 75 hp “crude column overhead re-circulating” pump loop had a pressure drop across the regulating valve of a little over 100 psi, making it another candidate for the application of a variable speed drive. This measure offers potential savings of about 113,000 kWh, or \$4,300 per year.

Management Support and Comments: The results of the assessment were presented and discussed with the plant’s Manager of Operations, Manager of Technical Services, and Engineering Manager. They were all in agreement and support implementing the near- and medium-term opportunities with due considerations for the long-term opportunities. Mr. Laube indicated that Focus on Energy Industrial Program has several programs that could support implementation of recommended measures.

DOE Contact at Plant/Company: DOE may contact Jerry Choate, 715-398-8235, jerry_choate@murphyoilcorp.com, to monitor progress made toward implementation of the recommendations.

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